Land Information System (LIS) Requirements

1 Introduction

The purpose of this document is to describe the requirements of the Land Information System (LIS) to be implemented under funding from NASA's Computational Technologies (formerly High Performance Computing and Communications) Project. The requirements given herein are derived from several sources, including 1) the original LIS proposal; 2) the LIS grand-kickoff meeting, held March 4, 2002; 3) a formal requirements gathering process conducted by members of the GSFC LIS team, and 4) input from others, including the full Global Land Data Assimilation System (GLDAS) and LIS teams.
The requirements are organized along the following topical areas:

- LIS General Requirements
- LIS Science Requirements
- Performance Requirements
- Usage Requirements
- Platforms
- Data Management
- Data Reliability and Security
- Online Documentation

2 LIS Description

The Land Information System (LIS) will have the following components: (1) A high-resolution (1km) global Land Data Assimilation System (GLDAS), involving several independent community Land Surface Schemes (LSS), land surface data assimilation technologies, and integrated database operations for observation and prediction data management; and (2) A web-based user interface based on the GRid Analysis and Display System (GrADS) and the Distributed Oceanographic Data System (DODS) for accessing data mining, numerical modeling, and visualization tools. The LIS will be available as a "production" system on a centralized server for large applications. By incorporating and promulgating the existing Assistance for Land_surface Modeling Activities (ALMA; http://www.lmd.jussieu.fr/ALMA/) and DODS standards for model coupling and data visualization, LIS will contribute to the definition of the land surface modeling and assimilation standards for the Earth System Modeling Framework (ESMF).

3 LIS General Requirements

3.1 GrADS-DODS for Data Management

Statement: LIS shall use a GrADS-DODS system for data management.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

3.2 GLDAS for Data Assimilation

Statement: LIS shall use GLDAS for data assimilation.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

3.3 CLM

Statement: The Community Land Model (CLM) shall run in LIS.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

3.4 NOAH

Statement: The NOAH Land Model shall run in LIS.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

3.5 VIC

Statement: The Variable Infiltration Capacity (VIC) Land Model shall run in LIS.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

3.6 ALMA for Input Variables

Statement: The Assistance for Land-surface Modeling Activities (ALMA) standard shall be used for input variables.

Source:

Priority:

Milestone:

Dependencies:

Notes:

3.7 ALMA for Output Variables

Statement: The ALMA standard shall be used for output variables.

Source:

Priority:

Milestone:

Dependencies:

Notes:

3.8 Internet-enabled User Interface

Statement: LIS shall provide a secured internet-enabled user interface.

Source: LIS Milestones

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

4 LIS Science Requirements

4.1 Land Surface Modeling

Statement: LIS shall support global, regional or local land surface modeling.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.2 Water and Energy Balance

Statement: LIS shall support water and energy balance modeling of the land surface.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.2.1 Computation at User-defined Time Intervals

Statement: LIS shall support computation, input and output of water and energy fluxes and state variables at user-defined time intervals during a simulation.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.3 Land/Water Mask

Statement: LIS shall support the definition of the land surface domain by a land/water mask to eliminate ocean points from a given grid.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4 Run-time Definition of Domain

Statement: LIS shall allow for the definition of the model application domain at run-time.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.1 Domain Definition

Statement: The model application domain definition shall include

- spatial resolution: 2x2.5 deg., 1/4 deg., 5km, 1km
- map projection: lat/lon, Goode Homolosine, Lambert-Conformal
- geoid: TBD
- horizontal extent: 60S–90N deg lat., 0–360 deg lon., maximum
- vertical layers: 10 soil, 5 snow for CLM; 4 layers for NOAH
- number of tiles or tile quantile (aka cutoff):
  - 1–M tiles per grid-cell at 1/4 deg. resolution
  - 1–N tiles per grid-cell at 5km resolution
  - 1 tile per grid-cell at 1km resolution

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.2 Dynamic Tile Use

Statement: LIS shall support dynamic definition of tiles during a given simulation.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.3 Tile Definition

Statement: LIS shall support a general definition of "tiles" or sub-grid patches based on a combination of dynamic and static properties, including vegetation, soils, topography, forcing, or other data as needed.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.4 Time-stepping

Statement: LIS shall be able to run at 900 and 1800 second time-steps.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.5 I/O

Statement: LIS shall support the input and output of 1-d, 2-d and 3-d gridded (raster) data as well as point data.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.6 Support for Time-dependent Variables

Statement: LIS shall support variables that change in time and 3-d space.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.7 Restart Support

Statement: LIS shall allow a "restarted" simulation to run over a redefined grid.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.8 Start-time and End-time

Statement: LIS shall allow for the definition of the model starting date and time and the ending date and time at runtime.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.9 Mandatory Output

Statement: LIS shall output all variables marked as "mandatory" by the ALMA standard.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.10 Output Frequency

Statement: LIS shall have a fixed output frequency during a given simulation.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.11 6-d Gridded Output

Statement: LIS shall support 6-d (t,x,y,z,tile,LSS) gridded output.

Source:

Priority:

Milestone:

Dependencies:

Notes:

4.4.12 Quality Control Output

Statement: LIS shall have the capability to output the gridded/interpolated input data for quality control/analysis purposes.

Source:

Priority:

Milestone:

Dependencies:

Notes:

5 Performance Requirements

5.1 1 ms per grid cell per day Throughput

Statement: LIS shall have a throughput of 1 ms per grid cell per day of execution on ESS test-bed for a near-term retrospective period computed at a 5 km resolution.

Source: LIS Milestones

Priority: 1

Milestone: F (Mar 2003)

Dependencies:

Notes:

5.2 0.4 ms per grid cell per day Throughput

Statement: LIS shall have a throughput of approximately 0.4 ms per grid cell per day of execution on the GSFC 974 Linux cluster for a near-term retrospective period computed at a 1 km resolution.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

6 Usage Requirements

6.1 User Levels

Statement: LIS shall have three different user-levels – general public, registered researcher, and developer.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.2 Web Browser User Interface

Statement: LIS shall have a secured internet-enabled user interface accessible via world wide web browsers.

Source: LIS Milestones, NASA Policy

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.2.1 Read-only Access for General Public

Statement: The LIS user interface shall provide the general public read-only access to processed data.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.2.1.1 Animated or Still Output Images

Statement: The LIS user interface shall provide output images in animation or still format.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)
Dependencies:
Notes:

6.2.1.2 Contour or Shaded Output Images
Statement: The LIS user interface shall provide output images in contour or shaded plot format.
Source: LIS Milestones
Priority: 2
Milestone: G (Feb 2004)
Dependencies:
Notes:

6.2.2 Password-restricted Access to Data

Statement: The LIS user interface shall provide password-restricted access to data via FTP or Grads-DODS Server for registered researchers and developers.

Source: Internal (?), NASA Policy

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.2.2.1 Near-real-time Access to Data
Statement: The LIS user interface shall provide access to data on the LIS GrADS-DODS server in near-real-time.
Source: Internal (?)
Priority: 3
Milestone: K (Aug 2004)
Dependencies:
Notes:

6.2.3 Password-restricted Access to Run Land Surface Models

Statement: The LIS user interface shall provide password-restricted access to perform Land Surface Modeling for registered researchers and developers.

Source: Internal (?), NASA Policy

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.3 Queuing System

Statement: LIS shall provide a queuing system on the GSFC 974 Linux cluster to monitor the demand requests.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

6.4 Initialization via Restart

Statement: LIS shall allow for the initialization of state variables using data or saved states from a previous run.

Source:

Priority:

Milestone:

Dependencies:

Notes:

6.5 Write Restart Data

Statement: LIS shall provide output of state variables for use in future initializations.

Source:

Priority:

Milestone:

Dependencies:

Notes:

7 Platforms

7.1 LIS Shall Run on LIS Cluster

Statement: LIS shall run on the LIS Linux cluster.

Source: LIS Milestones

Priority: 2

Milestone: G (Feb 2004)

Dependencies:

Notes:

7.2 GLDAS and LSM Shall Run on SGI Origin Cluster

Statement: Global LDAS and the NOAH, CLM, and VIC LSS shall run on the SGI Origin Cluster at 1/4 deg and 5km resolutions.

Source: LIS Milestones

Priority: 1, 1

Milestone: F (Mar 2003), I (Jul 2003)

Dependencies:

Notes:

7.3 Java Support Needed for User Interface

Statement: LIS user interface shall be supported on systems with Java support running the latest version of either Netscape or Internet Explorer.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8 Data Management

8.1 Data Management Shall Support LIS

Statement: The management of LIS input/output data shall support the near-real-time operation of LIS.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.2 GrADS/DODS I/O

Statement: LIS shall support I/O in any GrADS/DODS supported format.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.3 Input Data

Statement: LIS input data shall consist of

- GEOS forcing data
- NRL precipitation data
- AGRMET short wave radiation data

- AGRMET long wave radiation data

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.3.1 Input Data Sources

Statement: LIS shall be able to get input data from the following sources:

- GrADS-DODS servers via DODS protocol
- ALMA compliant providers with standard ALMA protocol
- Traditional data sources with direct, automatic fetch via FTP or HTTP.
- LIS-generated restart files.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.3.2 Re-mapping of Input Data

Statement: LIS shall be able to re-map input data between grids, points and tiles.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.3.3 Re-projecting of Input Data

Statement: LIS shall be able to re-project input data between lat/lon, Goode Homolosine, and Lambert-Conformal projections via ESMF projection libraries.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.3.4 Input Data Interpolation

Statement: LIS shall be able to interpolate input data as needed via the ipolates library or ESMF interpolation libraries.
Source:
Priority:
Milestone:
Dependencies:
Notes:

8.4 Output data

8.4.1 GRIB for Output Data Format

Statement: The primary format of LIS output data storage is GRIB, with accompanying metadata files.
Source:
Priority:
Milestone:
Dependencies:
Notes:

8.4.2 Output Data Conversion

Statement: LIS shall be able to convert output data to binary, HDF or netCDF format.
Source:
Priority:
Milestone:
Dependencies:
Notes:

8.4.3 Goode Homolosine for Output Data Projection

Statement: The primary projection of output data is Goode Homolosine.
Source:
Priority:
Milestone:
Dependencies:
Notes:

8.4.4 Re-projection of Output Data

Statement: The output data shall be able to be re-projected to lat/lon or Lambert-Conformal.
Source:
Priority:
Milestone:
Dependencies:
Notes:

8.5 Data Catalog

Statement: All LIS data shall be cataloged/indexed.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.6 Automatic Update to Catalog

Statement: The data catalogs and indexes shall be automatically updated.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.7 Backup of Data

Statement: LIS data shall be regularly backed up.

Source:

Priority:

Milestone:

Dependencies:

Notes:

8.8 Data Storage

Statement: LIS data shall be stored on disks with tape archives.

Source:

Priority:

Milestone:

Dependencies:

Notes:

9 Data Reliability and Security

9.1 Data Reliability

Statement: Safety fall-back mechanisms shall be built to ensure data reliability.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

9.2 Authentication and Authorization Enforcement

Statement: Authentication and authorization shall be enforced for users to have different levels of access to the data.

Source: Internal (?), NASA Policy

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

9.3 Access Monitoring

Statement: Access to certain data shall be monitored and logged.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

9.4 Usage Limited

Statement: Resource usage by Internet users shall be limited.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

10 Online User Documentation

10.1 On-line Overview and Help

Statement: The LIS web interface shall provide users with an on-line overview and help functions.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

10.2 FAQ

Statement: The LIS web interface shall provide users with a FAQ list.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

10.3 Highlights Page

Statement: The LIS web interface shall provide a "highlights" page showing examples of LIS applications.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes:

10.4 On-line Tutorial

Statement: The LIS web interface shall provide an online tutorial to learn system.

Source: Internal (?)

Priority: 3

Milestone: K (Aug 2004)

Dependencies:

Notes: